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Method and apparatus for joining at least two adjacently disposed work pieces by the method of friction stir welding

Patent claims

1. A method for joining at least two adjacently disposed work pieces (13, 14) by the method of friction stir welding, wherein the work pieces (13, 14) include between them a connecting area, using a rotating pin-like projection (11) which, upon rotation in contact with the connecting area of the workpieces (13, 14), at least partially plasticizes the connecting area, characterized in that, for generating the connection by the plasticizing material, the pin-like projection (11) is moved through the material being plasticized of at least the first work piece (13) disposed adjacent the pin-like projection (11) up to the surface of the lower work piece (14).

2. A method according to claim 1, characterized in that
The lower work piece (14) is joined with the work piece (13) disposed on top thereof in a material-locking manner.

3. A method according to claim 1 or 2, characterized in that oxides or oxide-containing compounds are removed from the surfaces of the lower work piece (14) and/or the upper work piece.

4. A method according to one or more of the claims 1 to 3, characterized in that the pin-like projection (11) is moved along the joint area.

5. A method according to one or more of the claims 1 to 4, characterized in that pressure is applied to the material while being plasticized.

6. A method according to claim 5, characterized in that the pressure is applied by a shoulder (12) of the pin-like projection (11).

7. A method according to one or more of the claims 1 to 6, characterized in that the work pieces (13, 14) are joined in a form-locking manner.

8. A method according to claim 7, characterized in that the work pieces (13, 14) are joined in a form-locking manner by the introduction of plasticized material into at least onecavity (16) formed in the lower work piece (14).

9. An apparatus for joining at least two work pieces (13, 14) by the method of friction stir welding, which work pieces (13, 14) are disposed closely adjacent each other in the area in which they are to be joined, comprising a rotatable shaft having a free end with a pin-like projection (11), which, upon rotation, is brought into contact with the area in which the

work pieces (13, 14) are to be joined for at least partially plasticizing the joint area, characterized in that the pin-like projection (11) is movable along its axis of rotation through the material of a first work piece (13) disposed adjacent the pin-like projection, while plasticizing the work piece materials up to the surface of a lowermost work piece (14).

10. An apparatus according to claim 9, characterized in that the length of said pin-like projection (11) corresponds essentially to the thickness of the at least one work piece disposed on top of the lowermost work piece (14).

11. An apparatus according to claim 9 or 10, characterized in that the pin-like projection (11) is disposed on a shoulder (12).

12. An apparatus according to one of claims 9 to 11, characterized in that the pin-like projection (11) and/or the shoulder (12) is/are provided with a wear layer.

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Summary

(in connection with Fig. 1b)

A method and apparatus (10) for joining at least two work pieces (13, 14) disposed on top of one another by the method of friction stir welding is proposed, wherein the work pieces (13, 145) include between them a connecting area, comprising at least partially plasticizing the area where the work pieces (13, 14) are to be joined by a rotating pin-like projection (11), which is in contact with the area of the jointure of the work pieces (13, 14). The pin-like projection (11) is movable essentially along its axis of rotation through the material being plasticized of at least a first work piece (13) disposed adjacent the pin-like projection (11) up to the surface of the lower work piece (14).